ENVIRONMENTAL ECONOMIC ASSESSMENT

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10 ENVIRONMENTAL ECONOMIC ASSESSMENT

10.1 INTRODUCTION

The execution of development projects has generated the need to carry out environmental studies to determine the possible environmental deterioration generated by them. As part of these studies, the environmental assessment of impacts represents an important alternative to assimilate some of the main effects, especially those related to human well-being. In this regard, the economy has generated different theoretical and methodological tools to complement and improve the quality of environmental assessment processes to strengthen decision-making from the public and private sectors[1]. The purpose of these tools is to identify and estimate the economic value of environmental impacts in such a way that can be included in the economic analysis and contribute to the determination of its feasibility.

Currently, the Ministry of Environment, Housing and Territorial Development requires studies of economic valuation of the environmental impacts involved in the execution of projects, through Decree 1076 of 2015 "by which the single regulatory decree of the environmental sector is issued and sustainable development "[2] and in which Chapter 3 - Environmental Licenses - details the application of the Environmental Impact Assessment -EIA, and through the General Methodology for the presentation of Environmental Studies of the Ministry of Environment, Housing and Territorial Development (MAVDT)[3], today Ministry of Environment and Sustainable Development (MADS), of 2010, which is supported by the "Methodology of economic evaluation of environmental impacts on projects related to environmental licensing, 2010[4]". According to this requirement, in this study the economic valuation of the main impacts associated with the modification of the construction and operation project of a port terminal of solid bulk of deep water in Bahía Colombia was made, so that it is a multipurpose port terminal; to ensure the integrity of the project.

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[1] COLOMBIA. MINISTRY OF ENVIRONMENT, HOUSING AND TERRITORIAL DEVELOPMENT - MEHTD. Economic evaluation of environmental impacts in projects subject to environmental licensing, Technical Manual. Bogotá DC, 2010. 98 p. (Document in discussion).
[2] COLOMBIA. MINISTRY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT - MESD. Decree 1076 of 2015. By which the single regulatory decree of the environment and sustainable development sector is issued. Bogotá DC, 2015. 174 p.
[3] COLOMBIA MINISTRY OF ENVIRONMENT, HOUSING AND TERRITORIAL DEVELOPMENT - MEHTD. General methodology for the presentation of environmental studies. Bogotá D.C. 2010, 72 p.
[4] CENTER OF STUDIES FOR THE ECONOMIC DEVELOPMENT - CEDE, UNIVERSITY OF THE ANDES. MINISTRY OF ENVIRONMENT, HOUSING AND TERRITORIAL DEVELOPMENTL – MESD. Economic evaluation of environmental impacts in projects subject to environmental licensing, technical manual (*Document in discussión*). 2010. 92p.

Accepting the methodology of economic evaluation of environmental impacts [5], for this project attention will be directed towards impacts that cannot be internalized, that is, those that cannot be completely reversed in terms of the impact generated.

10.1.1 Environmental economic evaluation

Because of the environmental assessment, it was determined that the stage responsible for the greatest negative impacts is the construction, mainly the activities related to clearing, cleaning, topsoil removal and full of the land, both in the construction stage of the Viaduct, dock and jetty, as of the ground terminal. On the other hand, the variation in the volume of vehicular traffic had impacts evaluated as critical in the activities of transport and storage in port, and loading and unloading of trucks, these impacts will be valued economically, as well as the impacts classified as severe, which are related to the activity of Material Transport in the construction stage, and the activities of Loading and Unloading of merchandise, both for liquids, solids and general cargo, as well as in the Operation and maintenance of infrastructure and associated facilities. the operation of the terminal. On the other hand, in the activity of transport, manufacture and driving of the piles, associated with the construction stage, the impact of alteration of the landscape was identified, which was evaluated as severe, and in the activity of Extraction of the material of the marine bed, also associated with the construction stage, the impacts of Alteration of marine aquatic habitats and Modification of the structure (distribution, abundance and composition) of the marine benthic communities were identified and evaluated as severe. Additionally, the impact was identified Variation in the coverage and quality of public services, which directly affects severely the construction stage, the activities Construction and operation of temporary facilities and Construction of infrastructure and facilities associated with the operation of the terminal and in the operation stage it affects the Operation and maintenance of infrastructure and facilities associated with the operation of the terminal. However, many of these impacts will be mitigated and / or compensated through the plans and programs proposed in Chapter 11 of this document, so that being internalized through them, it is not necessary to evaluate them from an economic point of view. For impacts whose associated plans do not mitigate or completely compensate for the damages generated, the economic evaluation will be carried out using the benefits transfer methodology, this methodology is explained in chapter 2, numeral 2.3.8.

[5] Ibid.

- **Variation in the volume of vehicular traffic**

For the project of construction and operation of a deep water multipurpose terminal in Bahía Colombia - Urabá, it was identified that one of the main negative impacts, is the Variation in the volume of vehicular traffic, both in the construction stage and in the operation stage. This impact is associated with the socioeconomic-cultural environment and the demographic component. The main negative effects of the variation in vehicular traffic volume are, among others, the following:

- Roads Accident
- Noise generated by trucks and equipment
- Road congestion in the port
- Road congestion in the communities surrounding the port
- Emission of gases coming from vehicles that transit, wait with the engine running, operation of machinery and vehicles that circulate at inadequate speeds.

In previous studies, for the port of New York and New Jersey, by Dr. Joseph Berechman, in his work entitled "Societal Full Marginal Costs of Port Expansion: The Case of NY"[6] estimated social costs are established for truck traffic, these consider emissions of gases, noise generated, marginal social cost of traffic, cost of accident risk and the costs associated with the deterioration of the road related to the use of trucks. This calculation was made considering a 10-mile route as can be seen in Table No. 10.1.1.

Table No. 10.1.1 Estimated social costs for truck traffic, in a 10-mile route.

Investment costs	**Social Costs**			
Road maintenance	Congestion	Accident rate	Air pollution	Noise
USD 0.06	USD 0,64	USD 1,01	USD 0,11	USD 0,16
TOTAL COSTS FOR A 10-MILE ROUTE.				**USD 1,98**

Source: Joseph Berechman, (2007), modified by Aqua & Terra Consultores Asociados S.A.S.

The section of track that is within the area of influence of the project, has a length of 2.5 km, thus the values must be adjusted to this length, which results in the costs that can be seen in Table No 10.1.2

[6] BERECHMAN, Joseph. Societal Full Marginal Costs of Port Expansion: The Case of NY, 2007

Table No. 10.1.2 Estimated social costs of the transit of trucks, for a 2.5 kilometers distance.

Investment costs	Social Costs			
Road maintenance	Congestion	Accident rate	Air pollution	Noise
USD 0,01	USD 0,10	USD 0,16	USD 0,02	USD 0,02
TOTAL COSTS FOR A 2,5 Km ROUTE.				**USD 0,31**

Source: Aqua & Terra Consultores Asociados S.A.S.

This resulting cost of USD 0.31 is per truck per route, which considers the traffic study prepared by Grupo Vial[7], which can be seen in Table No. 10.1.3. 20 years of port operation.

[7] GRUPO VIAL. Basic and detail engineering, procurement and supply of materials, construction, assembly and commissioning of the works required for phase 1 of the port terminal Antioquia located at the mouth of the Lion River, in the Gulf of Urabá, department of Antioquia. Traffic Study, Cali 2015, p. 162.

Table No. 10.1.3 Traffic Study Projections

TRAMO NUEVA COLONIA - PUERTO ANTIOQUIA									
AÑO	LIVIANOS	BUSES	CAMIONES						
	V24H	V24H	V24H C2P	V24H C2G	V24H C3	V24H C5	V24H >C5	TOTAL CAMIONES	TOTAL TPDS
2014									
2015									
2016									
2017									
2018									
2019	3655	2750	112	420	607	389	1221	2750	9154
2020	3784	2847	116	433	625	404	1270	2847	9477
2021	3894	2929	119	446	644	415	1305	2929	9752
2022	4006	3014	123	459	663	427	1342	3014	10034
2023	4122	3101	126	473	683	439	1380	3101	10325
2024	4242	3191	130	487	704	452	1419	3191	10624
2025	4365	3284	134	502	725	464	1459	3284	10932
2026	4492	3379	138	517	747	478	1500	3379	11250
2027	4622	3477	142	532	769	491	1542	3477	11576
2028	4756	3578	146	548	792	506	1586	3578	11912
2029	4894	3682	151	565	816	520	1631	3682	12258
2030	5037	3789	155	582	840	535	1677	3789	12615
2031	5188	3903	160	599	866	551	1727	3903	12993
2032	5343	4020	165	617	891	568	1779	4020	13383
2033	5504	4140	170	635	918	585	1833	4140	13784
2034	5669	4265	175	654	946	602	1888	4265	14198
2035	5839	4393	180	674	974	620	1944	4393	14624
2036	6014	4524	185	694	1003	639	2002	4524	15063
2037	6194	4660	191	715	1033	658	2063	4660	15515
2038	6380	4800	197	737	1064	678	2124	4800	15980
2039	6572	4944	203	759	1096	698	2188	4944	16459
2040	6769	5092	209	782	1129	719	2254	5092	16953

Source: Grupo Vial, 2015.
Tramo Nueva Colonia-Puerto Antioquia: Road section Nueva Colonia-Puerto Antioquia
Año: Year Liviano: Car / bike Buses: Buses Camiones:Trucks

From this study, an average of 3,807 trucks are extracted per day covering the 2.5 kilometers of the route between Nueva Colonia and the Port, with this number you can estimate the annual cost of the impacts generated by the variation in the volume of vehicular traffic, as can be seen in Table No. 10.1.4 on a daily basis.

Table No. 10.1.4 Total daily Costs for 3.807 Trucks

Investment costs	Social Costs			
Road maintenance	Congestion	Accident rate	Air pollution	Noise
USD 36,59	USD 374,70	USD 595,40	USD 67,27	USD 93,23
TOTAL DAILY COSTS FOR 3807 TRUCKS				**USD 1.167,19**

Source: Aqua & Terra Consultores Asociados S.A.S.

The annual cost per truck can be seen in Table No. 10.1.5.

Table No. 10.1.5 Total annual Costs for 3.807 Trucks

INVESTMENT COSTS	Social Costs			
Road maintenance	Congestion	Accident rate	Air pollution	Noise
USD 13.353,62	USD 136.766,95	USD 217.319,45	USD 24.553,44	USD 34.030,20
TOTAL ANNUAL COSTS FOR 3807 TRUCKS				**USD 426.023,67**

Source: Aqua & Terra Consultores Asociados S.A.S.

Finally, to obtain the average annual cost, the variation of the value of money over time must be considered, for this the variation of the inflation index of the last 10 years in Colombia will be taken, and the average of this index will be used as a value of the discount factor. You can see these values in Table No. 10.1.6

Table No. 10.1.6 Annual Inflation in Colombia, 2004 - 2014

YEAR	INFLATION
2004	5,5%
2005	4,85%
2006	4,48%
2007	5,69%
2008	7,67%
2009	2%
2010	3,17%
2011	3,73%
2012	2,44%
2013	1,94%
2014	3,66%
AVERAGE	**4,10%**

Source: Aqua & Terra Consultores Asociados S.A.S., with Republic Bank information.

With the average value of inflation of the last 10 years, it is possible to elaborate the projection of the annual cost of truck traffic for the 20 years of operation of the port, see Table No. 10.1.7

Table No. 10.1.7 Annual cost projected for 20 years of operation

YEAR	COST
2019	USD 426.023,67
2020	USD 443.490,64
2021	USD 461.673,75

YEAR	COST
2022	USD 480.602,38
2023	USD 500.307,08
2024	USD 520.819,67
2025	USD 542.173,27
2026	USD 564.402,38
2027	USD 587.542,87
2028	USD 611.632,13
2029	USD 636.709,05
2030	USD 662.814,12
2031	USD 689.989,50
2032	USD 718.279,07
2033	USD 747.728,51
2034	USD 778.385,38
2035	USD 810.299,18
2036	USD 843.521,45
2037	USD 878.105,82
2038	USD 914.108,16
2039	USD 951.586,60
2040	USD 990.601,65

Source: Aqua & Terra Consultores Asociados S.A.S.

Taking into account the payment that was fixed through resolution 606 of 2015, for a value of USD 2,194,204 per year as consideration for the development of port activities, 20%, ie USD 438,840.80, correspond to the municipality. On the other hand, the budgeted investment of USD 5,000,000 for the adaptation of the road that connects Nueva Colonia with Puerto Bahía Colombia in Urabá, obtains the following financial analysis (see Table No. 10.1.8).

Table No. 10.1.8 Net cash flow

EVALUACION FINANCIERA

INDICADORES FINANCIEROS

FLUJO NETO DE EFECTIVO

Año de construccion	Ingresos totales*	Egresos totales	Valor Residual	Inversion En la zona	Flujo Neto de Efectivo
0	438,840.80	426,023.67		5,000,000	5,012,817.13
1	438,840.80	443,490.64			-4,649.84
2	438,840.80	461,673.75			-22,832.95
3	438,840.80	480,602.38			-41,761.58
4	438,840.80	500,307.08			-61,466.28
5	438,840.80	520,819.67			-81,978.87
6	438,840.80	542,173.27			-103,332.47
7	438,840.80	564,402.38			-125,561.58
8	438,840.80	587,542.87			-148,702.07
9	438,840.80	611,632.13			-172,791.33
10	438,840.80	636,709.05			-197,868.25
11	438,840.80	662,814.12			-223,973.32
12	438,840.80	689,989.50			-251,148.70
13	438,840.80	718,279.07			-279,438.27
14	438,840.80	747,728.51			-308,887.71
15	438,840.80	778,385.38			-339,544.58
16	438,840.80	810,299.18			-371,458.38
17	438,840.80	843,521.45			-404,680.65
18	438,840.80	878,105.82			-439,265.02
19	438,840.80	914,108.16			-475,267.36
20	438,840.80	951,586.60			-512,745.80
21	438,840.80	990,601.65			-551,760.85

Source: Aqua & Terra Consultores Asociados S.A.S.
Evaluación financiera: Financial Evalution
Flujo neto de efectivo: Net cash Flow
Ingresos totales: Total income
Valor residual: Residual value
Indicadores financieros: Financial indicators
Año de construcción: Year of construction
Egresos totales: Total disbursements
Inversión en la zona: Investment in the area

Table No. 10.1.9 Calculation of Van Y R B/C with a discount rate of 4,1%

Año de operación	Costos totales ($)	Beneficios totales ($)	Factor de actualización 4.10%	Costos actualizados ($)	Beneficios actualizados ($)	Flujo neto de efectivo act. ($)
0	426,024	5,438,841	1.000	426,023.67	5,438,840.80	5,012,817.13
1	443,491	438,841	0.961	426,023.67	421,556.96	-4,466.70
2	461,674	438,841	0.923	426,023.67	404,953.86	-21,069.81
3	480,602	438,841	0.886	426,023.67	389,004.67	-37,019.00
4	500,307	438,841	0.852	426,023.67	373,683.64	-52,340.03
5	520,820	438,841	0.818	426,023.67	358,966.03	-67,057.64
6	542,173	438,841	0.786	426,023.67	344,828.08	-81,195.59
7	564,402	438,841	0.755	426,023.67	331,246.95	-94,776.71
8	587,543	438,841	0.725	426,023.67	318,200.72	-107,822.94
9	611,632	438,841	0.697	426,023.67	305,668.32	-120,355.35
10	636,709	438,841	0.669	426,023.67	293,629.51	-132,394.16
11	662,814	438,841	0.643	426,023.67	282,064.85	-143,958.81
12	689,989	438,841	0.617	426,023.67	270,955.67	-155,068.00
13	718,279	438,841	0.593	426,023.67	260,284.03	-165,739.64
14	747,729	438,841	0.570	426,023.67	250,032.69	-175,990.98
15	778,385	438,841	0.547	426,023.67	240,185.10	-185,838.57
16	810,299	438,841	0.526	426,023.67	230,725.36	-195,298.31
17	843,521	438,841	0.505	426,023.67	221,638.19	-204,385.48
18	878,106	438,841	0.485	426,023.67	212,908.92	-213,114.74
19	914,108	438,841	0.466	426,023.67	204,523.46	-221,500.20
20	951,587	438,841	0.448	426,023.67	196,468.26	-229,555.40
21	990,602	438,841	0.430	426,023.67	188,730.32	-237,293.35
Total	**14,760,796**	**14,654,498**		**9,372,520.68**	**11,539,096.39**	**2,166,575.70**

Source: Aqua & Terra Consultores Asociados S.A.S.
Año de operación: Operation year Costos totales: Total costs Beneficios totales: Total benefits
Factor de actualización: Update factor Costos actualizados: Updated costs
Beneficios actualizados:Updated benefits Flujo neto de efectivo: Net cash flow

As can be seen in Table No. 10.1.9, the cost of the negative effects regarding the variation in volume of vehicular traffic in the port will be completely compensated, in fact a positive balance will be obtained during the time of the operation.